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IoT Based Waste Management for Smart City

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ABSTRACT:In the present day scenario, many times we see that the garbage bins or Dust bin are placed at public places in the cities are overflowing due to increase in the waste every day. It creates unhygienic condition for the people and creates bad smell around the surroundings this leads in spreading some deadly diseases & human illness, to avoid such a situation we are planning to design "IoT Based Waste Management for Smart Cities". In this proposed System there are multiple dustbins located throughout the city or the Campus,these dustbins are provided with low cost embedded device which helps in tracking the level of the garbage bins and an unique ID will be provided for every dustbin in the city so that it is easy to identify which garbage bin is full. When the level reaches the threshold limit, thedevice will transmit the level along with the unique ID provided. These details can be accessed by the concern authorities from their place with the help of Internet and an immediate action can be made to clean the dustbins.

KEYWORDS: 8051 microcontroller, RF module, IR Sensors, RF Transmitters, Intel Galileo Gen2, RF Receiver

I. INTRODUCTION

Things(Embedded devices) that are connected to Internet and sometimes these devices can be controlled from the internet is commonly called as Internet of Things. In our system, the Smart dust bins are connected to the internet to get the real time information of the smart dustbins.In the recent years, there was a rapid growth in population which leads to more waste disposal. So a proper waste management system is necessary to avoid spreading some deadly diseases. Managing the smart bins by monitoring the status of it and accordingly taking the decision. There are multiple dustbins are located throughout the city or the Campus (Educational Institutions, Companies, Hospitalsetc.).These dustbins are interfaced with micro controller based system with IR Sensors and RF modules. Where the IR sensor detects the level of the dust in dustbin and sends the signals to micro controller the same signal are encoded and send through RF Transmitter and it is received and decoded by RF receiver at the Central System(Intel Galileo) and an Internet connection is enabled through a LAN cable from the modem. The data has been received,analyzed and processed in the cloud, which displays the status of the Garbage in the dustbin on the GUI on the web browser [5].

II. RELATED WORK

In [1], the ZigBee, GSM (Global System for Mobile Communication) and ARM7 is used to form the Integrated system to monitor the waste bins remotely. The sensors are placed in the common garbage bins placed at the public places. When the garbage reaches the level of the sensor, then that indication will be given to ARM 7 Controller. The controller will give indication to the driver of garbage collection truck as to which garbage bin is completely filled and needs urgent attention. ARM 7 will give indication by sending SMS using GSM technology.
In [2], they came to a point It isimportant to understand the societal concerns over the increased rate of resource consumption and waste productionand therefore the policy makers have encouraged recycling and reuse strategies to reduce the demand for rawmaterials and todecrease the quantity of waste going to landfill.
In [3],it is being proposed in this paper that introduction of an integrated system combined with an integrated system of Radio Frequency Identification, Global Position System, General Packet Radio Service , Geographic Information System and web camera will solve the problem of solid waste They also analyzed the actual performance of the system.In [4],this paper objective of the study was to determine the characterization of the waste andthe current system of management activities. The paper highlights an overview of the current municipal solid wastemanagement (MSWM) system of Thoubal Municipality and it concludes with a few suggestions, which may be beneficial to the authorities to work towards further improvement of the current management systems.

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In [5], the proposed system describes that the level of garbage in the dustbins is detected with the help of Sensor systems, and communicated to the authorized control room through GSM system. Microcontroller is used to interface the sensor system with GSM system. A GUI is also developed to monitor the desired information related to the garbage for different selected locations. This will help to manage the garbage collection efficiently
In [6], it describes the application of our model of "Smart Bin" in managing the waste collection system of an entire city. The network of sensors enabled smart bins connected through the cellular network generates a large amount of data, which is further analyzed and visualized at real time to gain insights about the status of waste around the city. This paper also aims at encouraging further research in the topic of waste management.

III. PROBLEM DEFINITION

As we have seen number of times the dustbins are getting overflown and concern person don't get the informationwithin a time and due to whichunsanitary condition formed in the surroundings, at the same time bad smell spread out due to waste, bad look of the city which paves the way for air pollution and to some harmful diseases around the locality which is easily spreadable.

i. Disadvantages of the existing system

- Time consuming and less effective: trucks go and empty containers whether they are full or not.
- High costs.
- Unhygienic Environment and look of the city.
- Bad smell spreads and may cause illness to human beings.
- More traffic and Noise.

ii. Advantages of the proposed system

- Real time information on the fill level of the dustbin.
- Deployment of dustbin based on the actual needs.
- Cost Reduction and resource optimization.
- Improves Environment quality
  -Fewer smells
  -Cleaner cities
- Intelligent management of the services in the city.
- Effective usage of dustbins.

IV. METHODOLOGY

i. Keil µVision IDE

During the implementation of our project we have utilized certain software. The source code for the ARM microcontroller was written in programming language C. The IDE used was KeilµVision.The µVision IDE from Keil combines project management, make facilities, source code editing, program debugging, and complete simulation in one powerful environment. The µVision development platform is easy-to-use and helps you quickly create embedded programs that work. The µVision editor and debugger are integrated in a single application that provides a seamless embedded project development environment.

ii. Arduino IDE

The ArduinoSoftware (IDE) is an open source software and it makes easy to the code and upload it to the board. I t runs on the different plant from Windows, MAC OS, Linux. The environment is written in Java and before running the IDE Java software to be installed on the machine this software can be used with any Arduino board.

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V. MATERIAL

i. 8051 Microcontroller

Here the 8051 microcontroller used to reads the data from the sensor and process the data received from sensor , and the same data wirelessly transmitted to the Central system (Intel Galileo microcontroller) using RF Transmitter.

- Made by Intel in 1981
- An 8-bit, single-chip microcontroller optimized for control applications
- 128 bytes RAM, 4096 bytes (4KB) ROM, 2 timers, 1 serial port, 4 I/O ports
- 40 pins in a dual in-line package (DIP) layout.

ii. IR Sensor

An Infrared (IR) sensor is used to detect level in the dustbin whether the dustbin is full or not.An IR sensor consists of an emitter, detector and associated circuitry. The circuit required to make an IR sensor consists of two parts; the emitter circuit and receiver circuit.

Emitter is simply an IR LED (Light Emitting Diode) and the detector is simply an IR photodiode which is sensitive to IR light of the same wavelength as that emitted by the IR LED. When IR light falls on the photodiode, its resistance and correspondingly, its output voltage, change in proportion to the magnitude of the IR light received. This is the underlying principle of working of the IR sensor.

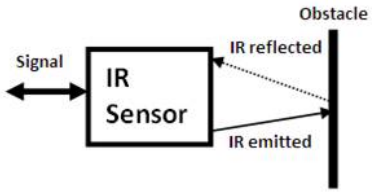

Fig 5.1. IR Sensor working

iii. RF Module

This radio frequency (RF) transmission system employs Amplitude Shift Keying (ASK) with transmitter/receiver (Tx/Rx) pair operating at 434 MHz The transmitter module takes serial input and transmits these signals through RF. The transmitted signals are received by the receiver module placed away from the source of transmission. The system allows one way communication between two nodes, namely, transmission and reception. The encoder converts the parallel inputs (from the remote switches) into serial set of signals. These signals are serially transferred through RF to the reception point. The decoder is used after the RF receiver to decode the serial format and retrieve the original signals as outputs. These outputs can be observed on corresponding LEDs.

iv. Intel Galileo Gen2

Intel is committed to providing the ultimate processors, boards, and tools to its community. The first initiative by Intel is the introduction of Intel Galileo and Intel Galileo Gen 2 boards, which are compatible with the Arduino headers and reference APIs. Intel Galileo boards are open source and open hardware; in other words, all the source code and hardware schematics are available online, which you can download, use, and modify.

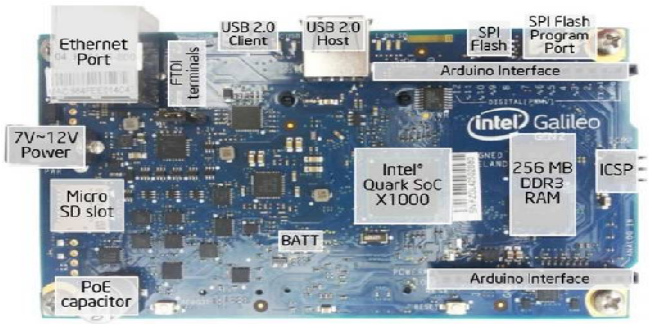

Fig 5.2. Intel Galileo Gen2

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The Intel Quark X1000 SoC was preserved on Intel Galileo Gen 2 as the memory'scapacity. It also has the same clock frequency, the same analog and power headers(except for a small improvement in the digital header to allow redirection of UART1 to thepins IO2 and IO3), and the same I2C and SPI speeds. The next section discusses the newchanges and improvements in details. In terms of Arduino headers, Intel Galileo Gen 2 provides the same set with majorimprovements, such as PWM. Figure shows its major components.

VI. WORKING PRINCIPLE

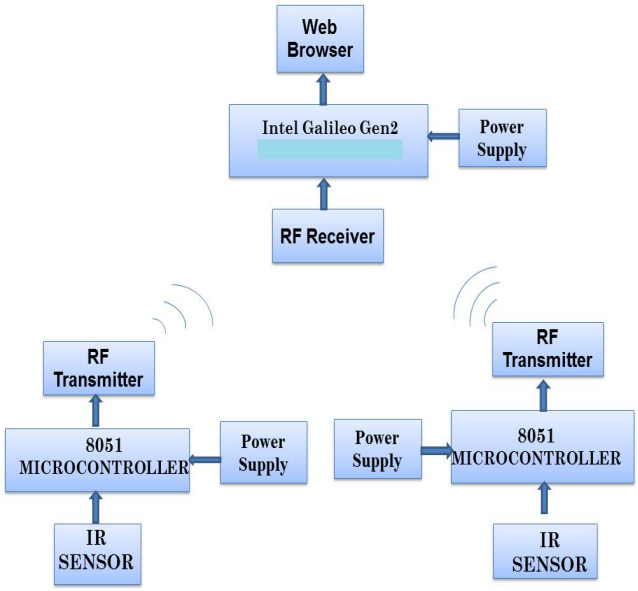

Fig 6.1. Block Diagram of the proposed System

The Block diagram shows the different component used in the Smart Dust bin System.IR Sensor, 8051 microcontroller, Power Supply, RF Transmitter, RF Receiver, Intel Galileo microcontroller and the web browser.The project module is divided into two parts Transmitter section and receiver section. Here in the transmitter section we are using 8051 microcontroller, RF Transmitter and sensors theseare attached to the dustbin.

Where sensor are used to detect the level in the dustbin whether the dustbin is full or empty. The sensor senses the content of the dustbin and sends the signals or the data to the 8051 microcontroller, Power Supply +9V Battery power supply is given to the 8051 microcontroller to drive the system and the 8051 microcontroller reads the data from the sensor and process the data received from sensor, and the same data wirelessly transmitted to the Central system (Intel Galileo microcontroller) using RF Transmitted.

RF Transmitter is to transmit the signal form 8051 microcontroller to the Intel Galileo microcontroller.
The other section is receiver section in which RF Receiver, Intel Galileo, and Web Browser is used. Here RF Receiver is used to receive the data sent by RF transmitter to the Intel Galileo microcontroller.
The Intel Galileo Gen2 Microcontroller is used to receive the data sent by the multiple transmitters and process the data and the same data transmitted to the Client i.e., Web Browser.

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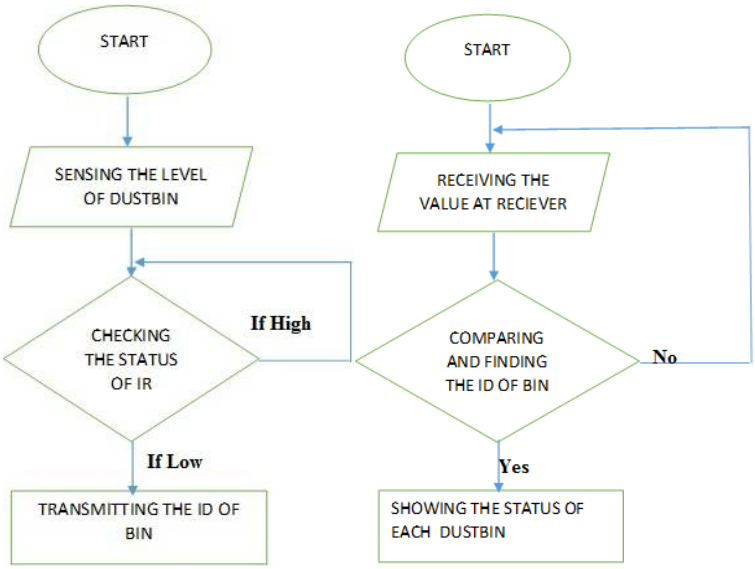

Fig 6.2. Flow chart of Transmitter Section

Fig 6.3. Flow chart of Receiver Section

Fig 6.2& Fig 6.3, shows the flow chart of the transmitter and the receiver section of the smart dustbin. Here in the transmitter section the sensors is deployed in the dustbin used to sense the level of the dust inside the dustbin and transmitting the signals to the microcontroller where the microcontroller check the status of dustbin and sends the signal to the central system through RF. Whereas in the receiver sections receives the values sent by the sender through RF receiver to the central system and check the all dustbin status and display on the browser.

VII. RESULTS AND DISCUSSION

The following are the results which obtained from this work,

- Waste Level detection inside the dustbin
- Transmit the information wirelessly to concerned
- The data can be accessed anytime and from anywhere
- The real-time data transmission and access
- Avoids the overflows of Dustbins

This IoT based waste management is very useful for smart cities in different aspects. We have seen that, in cities there are different dustbins located in the different area's and dustbins get over flown many times and the concerned people do not get information about this. Our system is designed to solve this issue and will provide complete details of the dustbin located in the different area's throughout the city. The concerned authority can access the information from anywhere and anytime to get the details. Accordingly they can take the decision on this immediately.

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Fig 7.1. Smart Dust Bin

Fig 7.1 shows that smart dustbin in which the IR sensor is deployed to detect the level of the dust inside the dustbin and 8051 microcontroller to read the IR sensor data and the RF transmitter module to transmit the dustbin level information to the central system.

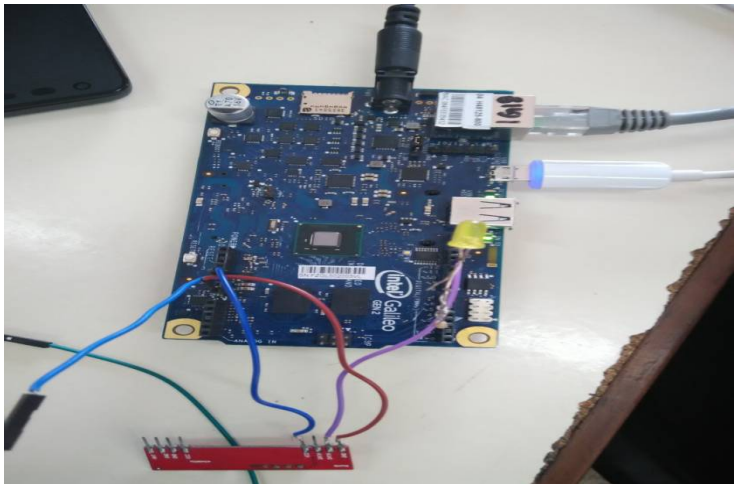

Fig 7.2. Central Server system(Intel Galileo)

Fig 7.2 shows that the central server system (Intel galileo Gen2) where the webserver is running and processing the information received from the smart dustbins and RF Receiver module to receive the data from the smart dustbins.

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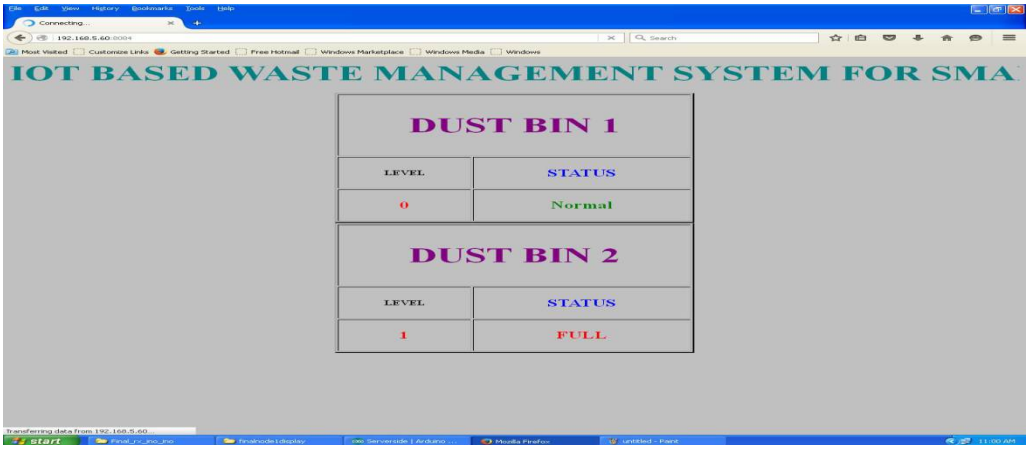

Fig 7.3. Information access Client/Browser

Fig 7.3 shows that all smart dustbins information displayed on the GUI web browser this information can be accessed from anytime and anywhere and the concern person take the decision accordingly.

VIII. CONCLUSION AND FUTURE WORK

We have implemented real time waste management system by using smart dustbins to check the fill level of smart dustbins whether the dustbin are full or not.In this system the information of all smart dustbins can be accessed from anywhere and anytime by the concern person and he/she can take a decision accordingly. By implementing this proposed system the cost reduction, resource optimization, effective usage of smart dustbins can be done.This system indirectly reducing traffic in the city. In major cities the garbage collection vehicle visit the area's everyday twice or thrice depends on the population of the particular area and sometimes these dustbins may not be full. Our System will inform the status of each and every dust bin in real time so that the concerned authority can send the garbage collection vehicle only when the dustbin is full.

The scope for the future work is this system can be implemented with time stamp in which real-time clock shown to the concern person at what time dust bin is full and at what time the waste is collected from the smart dustbins.

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